UNIVERSITI PUTRA MALAYSIA

DIGESTION OF SAGO BASED DIETS IN SHEEP

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By

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Abstract of thesis presented to the Senate of the University Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy.

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Chairman : Professor Dato' Mohd. Mahyuddin Mohd. Dahan, Ph.D.

Faculty : Agriculture

Sago (*Metroxylon sagu*, Rott.) pith meal (SPM) can be used as an excellent energy feed for ruminant livestock because the pith contains high amount of starch and some indigenous fibre. However, there is a lack of information on the nutritive properties of SPM and effects of feeding SPM on the digestion parameters of ruminant animal. Therefore, the objectives of the present studies were: to determine the physical and chemical caharacteristics of SPM; and to study the effects of feeding SPM based diets on the growth performance of lambs and on digestibility of the diets , especially in relation to nutrient flows and microbial protein synthesis, in sheep. The experimental diets used were SPM plus soya bean meal (Diet A), SPM plus soya bean meal and urea (Diet B) and SPM plus fish meal and urea (Diet C).

The crude protein content of SPM was less than 2% while the neutral detergent fibre (NDF), starch and gross energy (GE) contents on dry weight basis were 12.8%, 72.2% and 17.5 MJ/kg, respectively. Scanning electron microscopy revealed that SPM consisted mainly of starch granules, parenchyma cell walls and vascular bundle

fibres which were degraded *in situ* at different rates by the rumen microbes. The digestibility of organic matter in dry matter (DOMD) was similar for all the diets which averaged 77-78%, but the metabolisable (ME) and net energy for fattening (NE_f) values were: 10.4, 10.4, 11.0 MJ ME and 7.7, 7.7, 8.0 MJ NE_f ($P<0.05$) per kg of feed dry weight for the three diets, respectively. The performance responses of 21 lambs fed with the three diets showed that their final weights and average daily gains (ADG) were: Diet A, 28.9 kg and 122 g; Diet B, 21.9 kg and 50 g: Diet C, 24.6 kg and 76 g ($P<0.05$). The efficiencies of microbial protein synthesis measured in terms of g N/kg starch digested in the rumen for these respective diets were 81.3, 21.9 and 32.3 g ($P<0.10$).

In conclusion, sago-pith meal contains an energy value equivalent to maize grains but having additional benefits from the indigenous fibres which are necessary for cellulolysis and the roughage effect. To improve the efficiency of energy utilization from sago diets, ruminal pH depression due to rapid breakdown of starch need to be sufficiently controlled such as through proper feed processing, ration formulation and feeding regimen.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysis
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah.

PENCERNAAN DIET BERASASKAN SAGU DI DALAM BEBIRI

Oleh

YAHYA MUHAMAD

Januari 2000

Pengerusi : Profesor Dato' Mohd. Mahyuddin Mohd. Dahan, Ph.D.

Fakulti : Pertanian

Mil umbut sagu (*Metroxylon sagu*, Rott.) boleh digunakan sebagai makanan bertenaga yang baik bagi ternakan ruminan kerana mil ini mempunyai kandungan kanji yang tinggi dan sebahagiannya terdiri daripada gentian asal. Walau bagaimanapun, terdapat kekurangan maklumat mengenai sifat nutrien daripada mil umbut sago (MUS) serta kesan permakanannya ke atas parameter pencernaan dalam ternakan ruminan. Oleh itu, kajian dijalankan untuk menentukan ciri-ciri fisikal dan kimia MUS dan kesan diet berasaskan MUS ke atas prestasi pertumbuhan berbiri muda dan ke atas pencernaan diet, khasnya yang berkaitan dengan pengaliran nutrien dan sintesis protein mikrob. Diet-diet eksperimen ialah MUS dicampur dengan mil kacang soya (Diet A), MUS dicampur dengan mil kacang soya dan urea (Diet B), dan MUS dicampur dengan mil ikan dan urea (Diet C).

Kandungan protein kasar MUS adalah kurang daripada 2% sementara kandungan gentian neutral detergen (NDF), kanji dan tenaga kasar ialah masing-masing 12.8%, 72.2% dan 17.5 MJ/kg barasaskan bahan kering. Permerhatian melalui skaning

elektron mikroskop (SEM) menunjukkan bahawa MUS terbahagi secara kasarnya kepada butiran kanji, dinding sel parenkima dan gentian vaskular bundal yang mempunyai kadar pencernaan berbeza. Pencernaan bahan organik dalam bahan kering (DOMD) hampir sama bagi semua perlakuan iaitu purata 77-78% tetapi tenaga ungkaibina (TU) dan tenaga bersih untuk penggemukan (TB_g) setiap kg berat makanan secara kering ialah 10.4, 10.4 dan 11.1 MJ TU dan 7.7, 7.7 dan 8.1 MJ TB_g ($P<0.05$) masing-masing bagi perlakuan diet tersebut. Purata prestasi berat akhir dan tumbesaran harian 21 ekor bebiri muda yang diberi tiga jenis diet tersebut ialah: Diet A, 28.9 kg dan 122 g; Diet B, 21.9 kg dan 50 g; Diet C, 24.6 kg dan 76 g ($P<0.05$). Diukur dengan kadar g N mikrob/kg kanji tercerna dalam rumen, kecekapan sintesis mikrob ialah 81.3, 21.9 dan 32.3 g masing-masing bagi Diet A, B dan C.

Kesimpulanya, mil umbut sagu mengandungi nilai tenaga yang setara dengan bijirin jagung tetapi mempunyai faedah-faedah tambahan daripada gentian asal yang diperlukan untuk selulolisis dan kesan rufaj. Untuk meningkatkan kecekapan penggunaan tenaga dalam diet sago yang digunakan, penurunan pH rumen yang cepat akibat daripada pencernaan kanji perlulah dikawal secukupnya seperti melalui pemprosesan makanan, formulasi rangsum dan regimen pemakanan yang wajar.

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I certify that an Examination Committee met on 27 January, 2000 to conduct the final examination of Yahya Muhamad on his Doctor of Philosophy thesis entitled "Digestion of Sago Based Diets in Sheep" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of University Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Doctor of Philosophy.

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Date: 11 MAY 2000

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

(YAHYA MUHAMAD)

Date: 03 April, 2000

TABLE OF CONTENTS

Page

Page

Page

Page

Page

LIST OF TABLES

Table **Page**

LIST OF PLATES

LIST OF FIGURES

Figures **Page**

Figures **Page**

LIST OF ABBREVIATIONS

AAS	=	atomic absorption spectroscopy
ADF	=	acid detergent fibre
ARC	=	Agricultural Research Council (UK)
ATP	=	adenosine-5'-triphosphate
cal	=	calorie
CF	=	crude fibre
cm	=	centimetre
CP	=	crude protein
d	=	day
DE	=	digestible energy
d.f.	=	degree of freedom
dl	=	decilitre
DM	=	dry matter
DMI	=	dry matter intake
DOM	=	digestible organic matter
DOMD	=	digestible organic matter in dry matter (the "D" value)
EE	=	ether extract (crude fat)
g	=	gram
gc	=	gas chromathography
GE	=	gross energy
h	=	hour
ha	=	hectare
hd	=	head
HPLC	=	high-performance liquid chromatography
IBC	=	isolated bacteria cells
i.e.	=	that is
i.d.	=	internal diameter
kg	=	kilogram
kPa	=	kilopascal
l	=	litre
m	=	meter
mM	=	millimoles of solute per litre of solution
ME	=	metabolisable energy
mg	=	miligram
min	=	minute
MJ	=	megajoule
ml	=	mililitre
mm	=	milimetre
mt	=	metric ton
N	=	nitrogen
NDF	=	neutral detergent fibre
NE_l	=	net energy of lactation
NE_f	=	net energy of fattening
NFE	=	nitrogen free extract